Energy Efficiency Optimization in Supply Chain Networks

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Environmental considerations in supply chains are of increasing importance, especially with legislation set by governments and the rising awareness and expectations of consumers. This work describes the development of a model to address sustainability in supply chain networks in comparing environmental impact to cost optimization.

The base system studied in this work consists of a transportation link and storage node (Figure 1). An inventory management system is in place to fulfill a certain demand from a next stage in the network. Non-perishable goods are considered and the transportation is done by truck.

First, a detailed energy use infrastructure of the system is presented, taking into account the weight, speed and traffic congestion encountered by the vehicle during its journey. Fuel consumption during idling and water consumption are also considered. For storage energy, consumption due to actual storage space, office space and product handling are included.

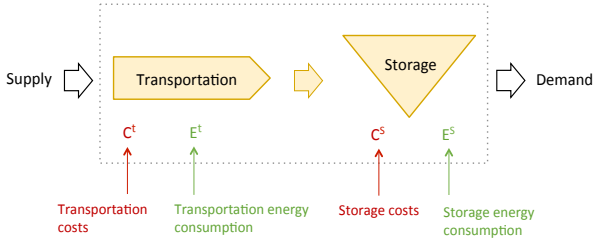

Figure 1: System of study

The model was implemented using the Arena software. It allows to quantify the energy consumption of the system, as well as the operating costs. Using the service level as a performance indicator, optimization to energy and costs can be compared. An example is shown in Figure 2.

By means of a case study, it is shown that the model can be a powerful tool to minimize the energy use or costs in a supply chain network. We find that the most energy efficient solution is not necessarily detrimental to the economic profits. Also a higher performance doesn't always mean higher energy use: increasing service level can decrease the energy use. We show that the model can be extended to describe an entire supply chain network.

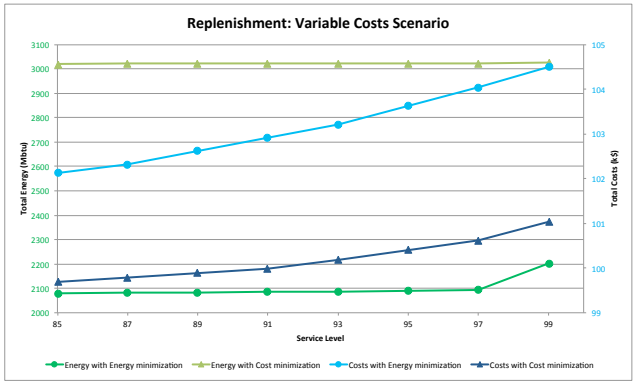

Figure 2: Optimization Results Example: Energy minimization and costs minimization comparison for variable transportation costs scenario.